

Citation:

Weggemans RM, Zock PL, Katan MB. Dietary cholesterol from eggs increases the ratio of total cholesterol to high-density lipoprotein cholesterol in humans: A meta-analysis. *Am J Clin Nutr*. 2001 May; 73(5): 885-891.

PubMed ID: [11333841](#)

Study Design:

Meta-analysis or Systematic Review

Class:

M - [Click here](#) for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To study the effect of dietary cholesterol from egg intake on the ratio of total to HDL-cholesterol (HDL-C) concentrations in humans.

Inclusion Criteria:

- Studies published in English
- The composition of the study diets varied only by the amount of cholesterol or the amount of eggs
- Subjects had to be weight stable throughout the study
- Study design had to eliminate the effect of non-specific drifts of the outcome variable over time (i.e., parallel, crossover or Latin-square design studies)
- Feeding period had to be 14 or more days to attain equilibrium in concentrations of total cholesterol (TC) and lipoproteins
- Studies had to report fasting concentrations of TC and lipoproteins.

Exclusion Criteria:

Studies with before and after designs or linear designs without a control group.

Description of Study Protocol:**Recruitment**

- Studies were found through a search of Medline from 1974 through June 1999 and Biological Abstracts from 1989 to June 1999 for experimental studies on the effects of dietary cholesterol and eggs on TC and lipoproteins. References of relevant articles were checked for additional studies

- Key words: egg, eggs, dietary cholesterol, serum (plasma) lipoprotein, serum (plasma) cholesterol, HDL and LDL.

Design

Meta-analysis.

Dietary Intake/Dietary Assessment Methodology

In the final sample, there were 11 metabolic ward studies in which all food was provided, five of which were free-living subjects who were provided eggs, high cholesterol products or egg-free substitutes.

Intervention

In the final sample, there were 11 metabolic ward studies in which all food was provided, five of which were free-living subjects who were provided eggs, high cholesterol products or egg-free substitutes.

Statistical Analysis

- Change in serum cholesterol was calculated by subtracting the mean concentration of serum cholesterol at the end of the low-cholesterol diet from that at the end of the high-cholesterol diet
- The mean ratios of total to HDL-C and of HDL- to LDL-C concentrations were estimated using the mean concentrations of total, LDL-, and HDL-cholesterol at the end of each diet
- For studies with a crossover or Latin-square design, the observed changes could be attributed fully to the change in dietary cholesterol or egg consumption because the study design eliminates drift of variables over time
- For studies with a parallel design, adjustments for the drift of variables over time were made by subtracting the changes in TC and lipoproteins in the control group from those in the treatment group
- Linear regression models were used to study the effect of dietary cholesterol on TC and lipoproteins. Each study was weighed by the number of subjects
- Publication bias was detected by plotting heterogeneity in funnel plots.

Data Collection Summary:

Timing of Measurements

Studies from 1974 to June 1999 were included in this meta-analysis.

Dependent Variables

- Change in serum cholesterol was calculated by subtracting the mean concentration of serum cholesterol at the end of the low-cholesterol diet from that at the end of the high-cholesterol diet
- The mean ratios of total to HDL-C and of HDL- to LDL-C concentrations were estimated using the mean concentrations of total, LDL- and HDL-C at the end of each diet.

Independent Variables

Dietary intake of egg and cholesterol.

Control Variables

Number of study subjects.

Description of Actual Data Sample:

- *Initial N*: 1,190 citations were found using Medline, 883 citations were found using Biological Abstracts and 221 citations were found using hand searches
- *Attrition (final N)*: N=17 studies, including 422 men and 134 women, including one unpublished study by the authors
- *Age*: Ranged from 18 to 75 years
- *Anthropometrics*:
 - Body Mass Index (BMI) ranged from 20.8kg/m² to 28kg/m²
 - Mean baseline cholesterol ranged from 4.06 to 5.93mmol per L (157 to 229mg per dL).

Summary of Results:

- The ratio of total to HDL-C and the concentrations of total and LDL-C increased relative to control groups or treatments after an increase in dietary cholesterol in all but one of the studies
- HDL-C concentrations increased in 19 of the 24 dietary comparisons
- The ratio of HDL- to LDL-cC concentrations decreased in all but one of the studies.

Predicted Changes in Serum Total Cholesterol Concentration and Lipoproteins Induced by a 100mg per Day Increase in Dietary Cholesterol

Serum Cholesterol Concentration	Predicted Change (95% CI)
Total cholesterol (mmol per L)	0.056±0.005 (0.046, 0.065)
<u>HDL-C</u> (mmol per L)	0.008±0.001 (0.005, 0.010)
<u>LDL-C</u> (mmol per L)	0.050±0.004 (0.042, 0.058)
Total:HDL-C (mmol per L)	0.020±0.005 (0.010, 0.030)
HDL:LDL-C (mmol per L)	-0.006±0.001 (-0.008, -0.004)

- Each additional 100mg dietary cholesterol would increase serum LDL-C by 0.036±0.004mmol per L in the studies with a background diet low in saturated fat and by 0.061±0.006mmol per L with background diet high in saturated fat
- Publication bias was not detected as indicated by the absence of heterogeneity in funnel plots.

Author Conclusion:

Reviewer Comments:

The consumption of cholesterol increases the ratio of total to HDL-C concentrations, which could predict increased risk of coronary heart disease.

Research Design and Implementation Criteria Checklist: Review Articles

Relevance Questions

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| 1. | Will the answer if true, have a direct bearing on the health of patients? | Yes |
| 2. | Is the outcome or topic something that patients/clients/population groups would care about? | Yes |
| 3. | Is the problem addressed in the review one that is relevant to nutrition or dietetics practice? | Yes |
| 4. | Will the information, if true, require a change in practice? | Yes |

Validity Questions

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| 1. | Was the question for the review clearly focused and appropriate? | Yes |
| 2. | Was the search strategy used to locate relevant studies comprehensive? Were the databases searched and the search terms used described? | Yes |
| 3. | Were explicit methods used to select studies to include in the review? Were inclusion/exclusion criteria specified and appropriate? Were selection methods unbiased? | Yes |
| 4. | Was there an appraisal of the quality and validity of studies included in the review? Were appraisal methods specified, appropriate, and reproducible? | No |
| 5. | Were specific treatments/interventions/exposures described? Were treatments similar enough to be combined? | Yes |
| 6. | Was the outcome of interest clearly indicated? Were other potential harms and benefits considered? | Yes |
| 7. | Were processes for data abstraction, synthesis, and analysis described? Were they applied consistently across studies and groups? Was there appropriate use of qualitative and/or quantitative synthesis? Was variation in findings among studies analyzed? Were heterogeneity issues considered? If data from studies were aggregated for meta-analysis, was the procedure described? | Yes |
| 8. | Are the results clearly presented in narrative and/or quantitative terms? If summary statistics are used, are levels of significance and/or confidence intervals included? | Yes |
| 9. | Are conclusions supported by results with biases and limitations taken into consideration? Are limitations of the review identified and discussed? | Yes |
| 10. | Was bias due to the review's funding or sponsorship unlikely? | Yes |

